Capacity of the UK construction sector

Lowe, John

Publication date:
2009

COBRA2009

10th - 11th September

RICS

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

SPES BONA

COBRA 2009

The Construction and Building Research Conference of the Royal Institution of Chartered Surveyors

Held at the University of Cape Town, 10-11 September 2009

ISBN 978-1-84219-519-2

12 Great George Street
London SW1P 3AD
United Kingdom

www.rics.org/cobra

September 2009

COBRA 2009

The construction and building research conference of the Royal Institution of Chartered Surveyors held at the University of Cape Town, 10-11 September 2009

The RICS COBRA Conference is held annually. The aim of COBRA is to provide a platform for the dissemination of original research and new developments within the specific disciplines, sub-disciplines or field of study of:

Management of the construction process

- Cost and value management
- Building technology
- Legal aspects of construction and procurement
- Public private partnerships
- Health and safety
- Procurement
- Risk management
- Project management

The built asset

- Property investment theory and practice
- Indirect property investment
- Property market forecasting
- Property pricing and appraisal
- Law of property, housing and land use planning
- Urban development
- Planning and property markets
- Financial analysis of the property market and property assets
- The dynamics of residential property markets
- Global comparative analysis of property markets
- Building occupation
- Sustainability and real estate
- Sustainability and environmental law
- Building performance

The property industry

- Information technology
- Innovation in education and training
- Human and organisational aspects of the industry
- Alternative dispute resolution and conflict management
- Professional education and training

Organising Committee

The Organising Committee for the RICS COBRA 2009 Conference consisted of:

Paul Bowen (Chair)	University of Cape Town
Ian Jay	University of Cape Town
Keith Cattell	University of Cape Town
Kathy Michell	University of Cape Town
Stephen Brown	RICS

The doctoral students' session was arranged and conducted by:

Monty Sutrisna	University of salford, UK
Les Ruddock	University of Salford, UK

The CIB W113 Law and dispute resolution session was aranged and conducted by Paul Chynoweth of the Univeristy of Salford, UK

Peer review process

All papers submitted to COBRA were subjected to a double-blind (peer review) refereeing process. Referees were drawn from an expert panel, representing respected academics from the construction and building research community. The conference organisers wish to extend their appreciation to the following members of the panel for their work, which is invaluable to the success of COBRA.

Rifat Akbiyikli	Sakarya University, Turkey
John Boon	UNITEC, New Zealand
Richard Burt	Auburn University, USA
Kate Carter	Heriot-Watt University, UK
Keith Cattell	University of Cape Town, South Africa
Sai On Cheung	City University of Hong Kong
Grace Ding	University of Technology Sydney, Australia
Peter Edwards	RMIT, Australia
Charles Egbu	University of Salford, UK
Hemanta Doloi	University of Melbourne, Australia
Peter Fenn	University of Manchester, UK
Peter Fisher	University of Northumbria, UK
Chris Fortune	University of Salford, UK
Rod Gameson	University of Wolverhampton, UK
Theo Haupt	Cape Peninsula University of Technology, South Africa
Godfaurd John	University of Central Lancashire, UK
Keith Jones	University of Greenwich, UK
Mohammed Kishk	Robert Gordon's University, UK
Andrew Knight	Nottingham Trent University, UK
Esra Kurul	Oxford Brookes University, UK
John Littlewood	University of Wales Institute, Cardiff, UK
Champika Liyanage	University of Central Lancashire, UK
Greg Lloyd	University of Ulster, UK
S M Lo	City University of Hong Kong
Martin Loosemore	University of New South Wales, Australia
Tinus Maritz	University of Pretoria, South Africa
Steven McCabe	Birmingham City University, UK
Andrew McCoy	Virginia Tech, USA
Kathy Michell	University of Cape Town, South Africa
Henry Odeyinka	University of Ulster, UK
Robert Pearl	University of KwaZulu-Natal, South Africa
Keith Potts	University of Wolverhampton, UK
Matthijs Prins	Delft University of Technology, The Netherlands
Richard Reed	Deakin University, Australia
Herbert Robinson	London South Bank University, UK
David Root	University of Cape Town, South Africa

Kathy Roper	Georgia Institute of Technology, USA
Steve Rowlinson	University of Hong Kong
Winston Shakantu	Nelson Mandela Metropolitan University, South Africa
Melanie Smith	Leeds Metropolitan University, UK
Suresh Subashini	University of Wolverhampton, UK
Ming Sun	University of the West of England, UK
Joe Tah	Oxford Brookes University, UK
Derek Thomson	Heriot-Watt University, UK
Basie Verster	University of the Free State, South Africa
John Wall	Waterford Institute of Technology, Ireland
Sara Wilkinson	Deakin University, Australia
Francis Wong	Hong Kong Polytechnic University
Ing Liang Wong	Glasgow Caledonian Unversity, UK
Andrew Wright	De Montfort University, UK
George Zillante	University of South Australia
Sam Zulu	Leeds Metropolitan University, UK

In addition to this, the following specialist panel of peer-review experts assessed papers for the COBRA session arranged by CIB W113, Law and dispute resolution:

John Adriaanse	London South Bank University, UK
Julie Adshead	University of Salford, UK
Rachelle Alterman	Technion, Israel
Jane Ball	University of Sheffield, UK
Michael Brand	University of New South Wales, Australia
Penny Brooker	University of Wolverhampton, UK
Alice Christudason	National University of Singapore
Paul Chynoweth	University of Salford, UK
Philip Chan	National University of Singapore
Sai On Cheung	City University of Hong Kong
Ron Craig	Loughborough University, UK
Asanga Gunawansa	National University of Singapore
Rob Home	Anglia Ruskin University, UK
Peter Kennedy	Glasgow Caledonian University, UK
Anthony Lavers	Keating Chambers, UK
Tim McLernon	University of Ulster, UK
Wayne Lord	Loughborough University, UK
Frits Meijer	Delft University of Technology, The Netherlands
Jim Mason	University of the West of England, UK
Brodie McAdam	University of Salford, UK
Tinus Maritz	University of Pretoria, South Africa
Mark Massyn	University of Cape Town, South Africa
Issaka Ndekugri	University of Wolverhampton, UK
Robert Pearl	University of KwaZulu-Natal, South Africa
Linda Thomas-Mobley	Georgia Tech, USA
Yvonne Scannell	Trinity College Dublin, Ireland
Cathy Sherry	University of New South Wales, Australia
Henk Visscher	Delft University of Technology, The Netherlands

RICS COBRA Research Conference, University of Cape Town, 10-11th September 2009.
John Lowe, pp 672-697

Capacity of the UK construction sector

John Lowe[1]

[1]School of the Built and Natural Environment,
Glasgow Caledonian University, Glasgow G4 OBA,
Scotland

Email: J.Lowe@gcal.ac.uk

Abstract:

Concern has been raised if the construction sector can cope with the demands currently being placed on it by the government and private sectors. This will paper identify three alternative definitions of the capacity limits of the UK construction sector. The economic limit on capacity is the point where the long-term cost curve rises as diseconomies of scale start to impact on production. The planning limit is the point at which the price escalation starts to become politically unacceptable. The technological limit is the maximum output that the industry can produce.

An analysis UK of the UK construction output over the past thirty years will identify the periods when the output of the construction sector was over the planning limit and when it was below the economic limit. These are undesirable as it will involve escalating tender prices in the former case and unemployment in the latter case. The more desirable periods when output was between the economic limit and the planning limit will also be identified.

Surveys of capacity utilization by members of the Construction Confederation will be used to calibrate the model. Based on the analysis it is expected that the economic limit for the UK construction sectors is around 80% of the technological capacity while the planning limit is probably in the region of 85% of technological capacity.

The paper will conclude that the industry was operating at or near to the planning capacity prior to the current recession. It was consequently on the margin of sustainability. This could lead to future problems when the industry recovers.

Keywords:

Capacity, sustainability, tender price escalation, resource inputs.

1: Introduction

1.1: The capacity problem

Prior to the recent economic downturn there was concern that the Government's programme of public service renewal would place great strains on the construction sector with massive expenditure planned on housing (£3B), schools (£5B), hospitals

(£4B), and defence (£5B). That is before account is taken of the railway infrastructure renewals and the impact of the 2012 London Olympics (Brown, 2004).

The Chartered Institute of Building (CIOB) also expressed some concern about the ability of the construction sector to meet this challenge due to skill shortage particularly in the area of management and professional staffing. The Construction Confederation appear confident that the industry can cope with the likely demand, however the CIOB have argued that there should be a systematic review of the capacity of the industry to deal with the expected demand. They further argue that strategies be developed to ensure that the industry can expand to deliver the required workload (Brown, 2004). Similar problems have been experienced in recruiting civil and structural engineers (Kitching, 2006).

The objective of this paper is to identify the sustainable capacity of the UK construction by reference to economic data — notably construction output, changes in construction costs and tender prices — over the past thirty years. The study will focus on the main peaks and troughs in UK construction output such as the unsustainable boom of the early 1970s and late 1980s and the subsequent recessions.

1.2: Background

The construction sector is critical to the early stages of economic growth. The construction of industrial and commercial buildings along with concomitant developments in roads and other infrastructure are a precondition to economic expansion. Capacity limits on the construction sector can be expected to act as a constraining factor on overall economic growth. There are a number of examples from recent history of attempts at economic recovery foundering due to the failure of the construction sector to deliver.

For example, in the 1930s USA, there was the New Deal, instigated by President Franklin Roosevelt. This was an attempt to drive the US economy out of the great depression by 'pump priming' by major construction works especially hydroelectric projects. Examples include the Tennessee Valley Authority and the Grand Coulee Dam. The aim was to generate jobs and economic activity during the publicly funded construction phase with the expectation that the private sector would take advantage of the infrastructure developments and the electrification.

The policy was partially successful; however it did not achieve its main objective. Some have attributed the failure of the new deal to end the great depression on the decision to fund the programme by taxation rather than borrowing as Keynes subsequently argued. It has also been suggested that 'bottlenecks' in the construction sector and skill shortages were also to blame.

Similarly, in the early 1970s, there was an attempt to expand the UK economy out of economic difficulties, the dash for growth. This expansionist approach was based, to a large extent, on the promotion of major projects and the use of housing improvement grants. The major projects promoted during this period included the Humber Bridge and Concorde.

There were also the subsequently unsuccessful attempts the build a massive integrated airport and seaport on the Essex coast at Maplin, and the Channel Tunnel and also to cover much of central London with concentric motorway rings. The final phase of the new town programme was under way by this stage. This involved creating new cities based on existing towns such as Milton Keynes and Northampton.

The dash for growth failed partially due to lack of capacity in the construction sector. Rising tender prices — see the 'Wood Report' also known as the Public Client and the Construction Sector (NEDO, 1975) — followed and in turn caused demand to be choked off. The strategy was already in the process of collapsed by the time of the Arab-Israeli war and the subsequent hike in oil prices. OPEC's action on oil prices contributed to a shift away of public and financial opinion that caused the scrapping of the Channel Tunnel, the London motorway 'box', and Maplin (Hall, 1982). Subsequently the ambitious new town programme was scaled down considerably.

1.3: Definitions of capacity

Following Hillebrandt (1975), it is possible to identify three approaches to the definition of capacity:

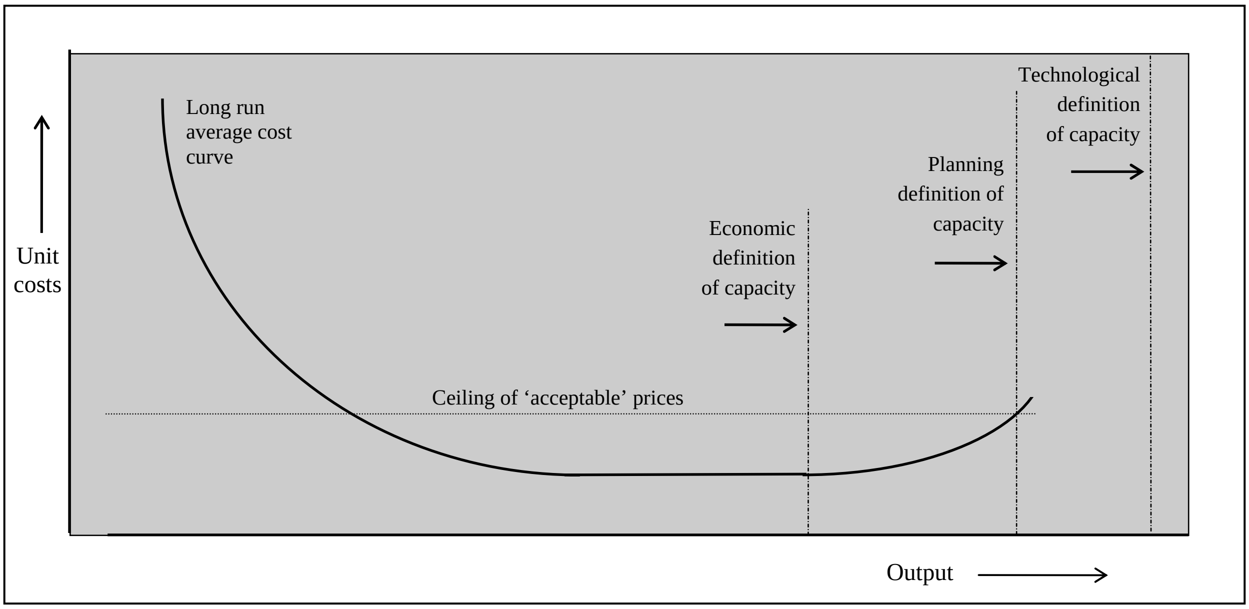
i) The technological definition: the maximum sustainable output assuming all productive units are operating to their full extent. This approach ignores economic factors and consequentially has limited applications except under extreme conditions such as war.

ii) The economic definition: the point at which long run average costs start to rise and diseconomies of scale arise. This approach takes account only of economic factors. It is based on assumptions of perfect competition that are not appropriate for the construction sector.

iii) The planning definition: the maximum output attainable within the limits or conditions considered 'acceptable' at the time. What is 'acceptable' in this context is determined by subjectively by the government of the day in the context of economic policy and political priorities.

The third definition remains somewhat of a compromise between the first two approaches. The limiting factor is the degree of price escalation acceptable. This will be determined by the counter-inflationary policy of the government and also by the price elasticity of demand for the products of the industry. While this type of approach is not as fashionable today as it was in the halcyon days of economic planning in the 1960s, it remains an important issue for all governments. Figure Number 1 below illustrates the distinction between the three approaches.

Figure Number 1: Alternative definitions of capacity



Hillebrandt (1975) argued that capacity couldn't be considered without reference to the time scales in question. Time would permit personnel to be recruited and trained, material production to be built-up, plant acquired and capital to be raised. Effectively capacity is a dynamic not a static concept. Capacity can expand to meet sustained higher demand just as it can contract to cope with continued falling demand. Thus it might be better to consider capacity in the context of the rate of growth of output. The capacity limit will correspond to the sustainability of the growth rate.

Similarly account needs to be taken of policy issues pertaining to training, health and safety, innovation, etc. These can have an impact on the ability of an industry to react to changing demand within a short time period. It is also necessary to take account of the mix of output.

Thus a higher output may be possible for a scenario based on new towns and large scale civil engineering projects, characterized by that of the UK in the early 1970s, than one based on housing improvement and inner city refurbishment more typical of the late 1970s. Thus the precise mix of work can have an impact on the output that is likely to be delivered by the industry even with the same level of resource availability. This is tied up with the productivity that is obtainable.

2: Approaches to the study of capacity

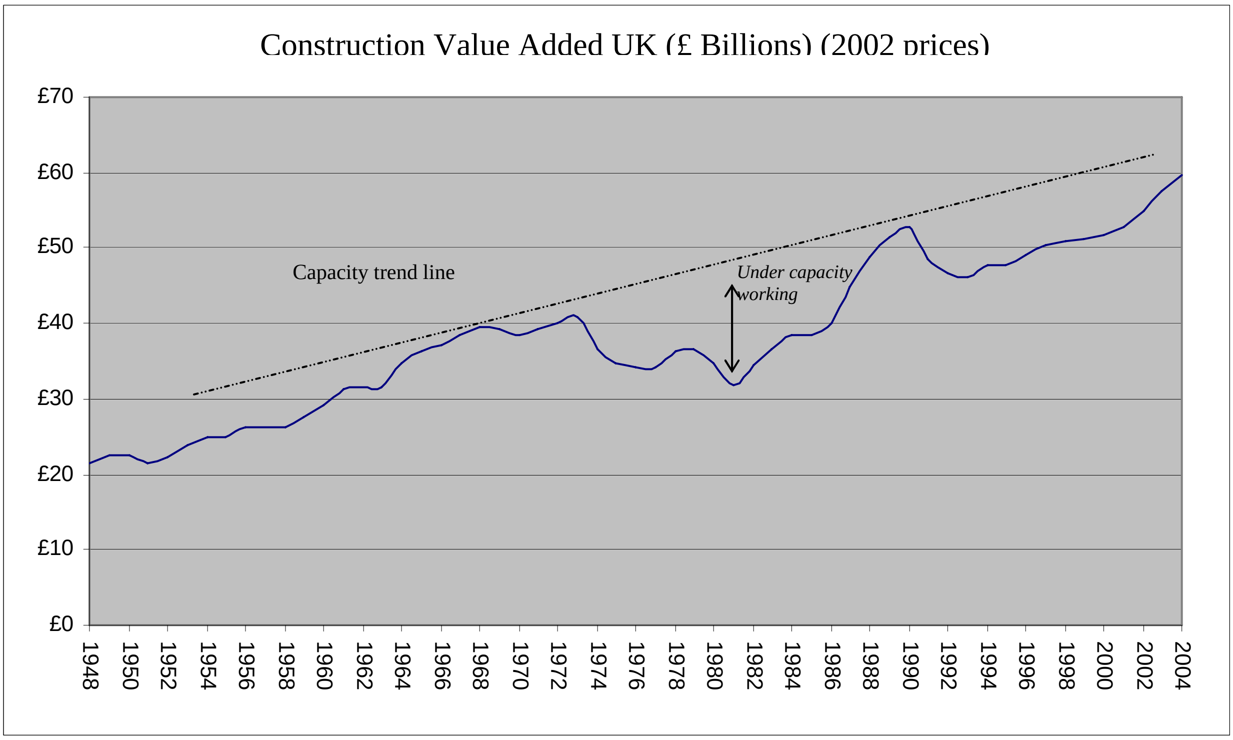
2.1: Time series approach

Taylor et al (1970) suggested this approach in a study of nineteen sectors of the UK economy for the period 1948 to 1968. The output in constant price terms is presented in a time series as Figure Number 1 below. A trend line joining the ‘peaks’ in the time series diagram can be assumed as the capacity. Under capacity working can be estimated by the gap between the time series and the trend line. While Hillebrandt (1975) saw this approach as being acceptable for a general comparative study of a variety of industrial sectors, it is likely to as be uninformative for an in-depth study of an individual industry.

The approach is also flawed in that it rests on the assumption that what was achieved in the past can be repeated. Thus the peak output achieved by the industry may no longer be viable. It may not be possible to replicate past achievements if operatives and staff have retired, or quarries have been exhausted, and materials plants closed. It is also highly dependent on price indices to convert output at current prices to constant prices. Errors in the price indices could distort the time series and give rise to misleading outcomes. Also new facilities can be brought into use and new staff trained to enable the industry to surpass previous peaks.

It is essential that the time series be based on constant price data. Errors in preparation of the index numbers necessary to produce a constant price series could distort the trends identified.
Time series graphs are useful in that they illustrate year-on-year changes in output achieved in the past. This is likely to be useful in assessing potential changes in the future.

Figure Number 2: Time series approach to construction capacity



2.2: Resources as determinants of output

John Parry Lewis (1967) outlined an approach to the problem by linking output to resource inputs in a report for the National Economic Development Office. See also Panic (1978) for a study of capacity utilization in UK manufacturing. This approach rests on the assumption that the ratio between the key resource inputs and outputs is relatively stable.

The Building Research Establishment carried out a number of investigations into resource usage in the 1970s. Given the coefficients of inputs necessary to produce a given level of output, the capacity can be modelled by a series of linear equations. It is necessary to identify the available quantity of the resources in question. This would include home production and, where relevant, imports.

Thus if the original question was questioning the maximum feasible output of the construction sector, this would lead to a number of further questions as to what the maximum feasible output of the brick industry, cement industry, the steel industry, etc., as well as availability of the primary inputs: labour and capital. This approach suggests that the constraining factor on construction output will be determined by the availability and cost of the various inputs needed for the construction process.

2.3: Input-output approach

This has parallels to those points addressed within the input-output framework developed by Wassily Leontief. While this approach was not developed specifically to deal with problems of resource limitation, it can be adapted for this purpose. Input-output analysis deals with inter-industrial relationships — for example, the inputs required from the various materials supply industries to produce construction projects — that have similarities to the resource issue outlined above. It, again, rests on the assumptions of fairly stable technical coefficients. These are the quantity of inputs required to produce a unit of output.

Figure Number 3 below illustrates the inputs and inputs affecting construction using this approach. The inputs to the construction process can be divided into *primary* inputs — labour, land, and capital — and *intermediate* inputs such as materials, components, transport and professional services. The approach concentrates on the relationships between outputs and intermediate and primary inputs.

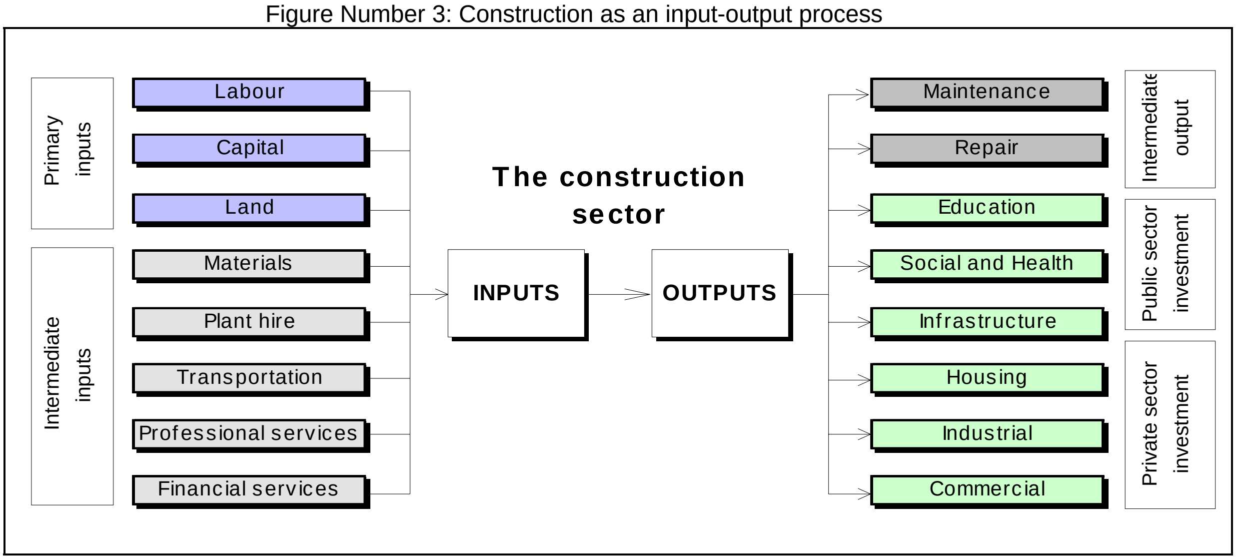
This approach facilitates the quantification of the inputs and outputs. Coefficients representing the value of each input needed to produce a set amount of output. For example in the UK in 1995, the inputs to construction from the structural clay industry amounted to just under £407M. With the gross output of construction at £87,602, this amounts to a direct input of £4.65 per £1,000 of construction output.

The approach also allows for indirect input to be computed. This would involve the use of structural clay products by industries that supply construction. Direct and indirect inputs of structural clay products to construction amounted to £6.65 per £1,000 of gross output in 1995.

The above technique allows us to identify the production of key inputs (direct and indirect) including labour to enable the construction industry to produce a target output.

With knowledge of the supply-side input output coefficients and with information on the availability of key resources likely to be in short supply, it should be possible to check possible output scenarios for construction to see if they are achievable without unintended consequences such as escalating tender prices.

Figure Number 3: Construction as an input-output process



2.4: The industry as a bottleneck

An alternative explanation is that it is the industry and the individual firms, as organic entities, that create the bottlenecks and escalating prices rather than the resources that they employ. If this case it is the poor organization within the industry rather than pressure on resource inputs that causes the difficulties.

3: Constraining Factors

3.1: Raw materials and manufactured components

Raw materials could act as a constraining factor on construction output. It used to be thought that in the short-run, running-down stocks of materials could increase capacity. This was limited by the amount held for each material and component — less than one month's supply for cement and plasterboard, and one to for months supply for bricks, tiles and pipes — thus this will be useful only in the very short term. With current thinking moving away from holding stocks of materials, this will no longer apply.

Some increase in output of the materials may be possible due to increased utilization of plant in the materials supply industries. Improvement in output is also possible by introducing additional shifts and/or weekend working. Each material will, however, have to be considered separately with particular attention to those materials that are anticipated to be critical. Such expansion could reduce unit costs by spreading fixed charges over the higher output or could increase costs because of non-productive overtime and premium payments.

Increases in capacity for materials supply have been achieved by installing modern plant while keeping the obsolete plant on standby to satisfy the fluctuations in demand.

In periods of high demand at home, is likely that imports will be drawn in and exports reduced. Construction has a lower marginal propensity to import than most other industries because of the low price/weight ratio of most building materials. Thus this particular issue will yield little extra for raw materials, although manufactured components may be significant. The diversion of materials and/or components destined for export to the home market might prove more important.

3.2: Site Operatives

Shortages of labour could certainly impair the growth of the construction sector. The increase in output would depend on the ability of the industry to recruit labour. This might come from the ranks of the unemployed or from other sectors using the same skill base. Given time it could come through additional training or from improved productivity. It is more likely; however, that additional labour will be imported from overseas. In the past, Ireland has proved a major source of labour for construction.

Now it is more likely to be from Eastern Europe. Allowance for retirements and those moving out to and in from other sectors plus the impact of any productivity gains. Table number 1 below summarizes these issues

If labour were assumed to be a factor likely to constrain construction output the impact would depend on the various categories of labour likely to be in short supply. Key skills such as joinery and plumbing would have the most impact.

Table Number 1: Constraining Factors for the Construction Sector

After Hillebrandt (1975)

Time scale	***Constraining factors***	
	Operatives	**Materials**
Immediate short run	❑ Unemployed workers ❑ Overtime, shifts ❑ Increase hours worked	❑ Run down stocks ❑ Extra utilization of existing plant capacity
Future capacity with no major policy decisions	❑ Increase productivity ❑ Attract labour from: a) Other sectors and industries b) Other countries ❑ Additional training from: a) Government training schemes b) Apprenticeship c) Other training ❑ Reduce wastage of manpower ❑ Improve labour productivity	❑ Increase productivity in materials sector ❑ Change in balance of imports over exports
Future capacity with major policy decisions	❑ Mechanization and automation ❑ Pre-fabrication and system building ❑ Change in policy on: a) Distribution of labour b) Immigration c) Training	❑ Change in fixed plant & buildings ❑ Changes in the production process ❑ Changes in trade policy

The above table summarizes the main points from a previous paper looking at manpower issues relating to construction capacity (Hillebrandt, 1975). The factors are classified as to their timescale – immediate short-run – and if governmental policy changes are involved or not.

3.3: Managerial and administrative staff

Shortages of professional, technical, administrative and above all managerial staff is considered by many to be the real constraining factor on capacity for the industry. This may not apply for the individual firms since mobility of managerial staff suggests that they can always be recruited, but will certainly affect the industry as a whole. The approach to this question is similar to that for operatives.

Very little additional output is likely to be obtained from the recruitment of extra staff in isolation. However, is certainly imposes limits to growth if other factors are introduced and efficient production is to be maintained. Companies will not operate efficiently if they lack managerial staff with the key skills needed to finish contracts on time and on budget.

3.4: Capital

Fixed capital should not present a problem. Plant and equipment used in construction is unlikely to be in short supply and the level of imports of machines could be stepped up to deal with any problems likely to be encountered in the future. Even if it became a problem, it is doubtful if this would seriously inhibit construction output given the ability of firms to substitute labour for capital.

Working capital could present more of a problem if firms were being inhibited by lack of bank loans etc. This has been a problem for small to medium construction companies with poor credit ratings particularly during periods up to the 1970s when a credit squeeze was in operation. However, while this may impact on individual firms it is extremely unlikely to produce a significant effect on the overall output. Larger firms with better credit ratings would absorb such work.

3.5: Land

The availability of land has proved to be a constraining factor for private housing development, particularly in the Southeast of England. The application of green belt policy has resulted in a shortage of land that has been partially addressed through the increased use of Brownfield land. Land can be seen as restraining the expansion of speculative housing.

3.6: Services

There are significant inputs from services sectors such as transportation, professional services (including architecture and surveying consultancy), financial services, and hiring and lasing of plant. It is unlikely that any of these sectors could significantly inhibit construction output.

3.7: Company and industry organization

There remains a possibility that the industry organization and companies themselves might introduce constraints into the output. The once dominant traditional mode of procurement separates design from construction and operates with a culture of confrontation and conflict.

Similarly it could be that the operation of the firms themselves might not make the best of available resources to a lack of entrepreneurship. The incidence of insolvency in construction is the highest amongst UK industries. The industry has also been attacked for neglecting training and helping to create one of the bottlenecks listed above.

It these points are accepted it could be argued that capacity is not entirely determined by the resource inputs as suggested by Parry Lewis (1967). Thus the industry itself could be seen as introducing additional constraints in the process of turning inputs into outputs.

Ball et al (2000) argue that the construction firm is the embodiment of the site managerial and professional skills covered earlier. Thus shortages of management and professional staff could be seen as an industry issue rather than a resource input issue.

4: Analysis

4.1: Introduction

The approach selected for this paper is to counterpoise changes in resource input costs with tender prices changes. If tender price escalation is running ahead of resource input cost increases, this will be indicative that the industry is approaching ts effective capacity. If the reverse is the case it is probably that the industry s operating below capacity.

The theoretical justification for this is presented below.

4.2: Time series analysis

As expected, basic time series analysis does not yield much information. Figure Number 2 above illustrates the value added for the UK construction sector from 1948 to 2004 in constant (2002) prices. It shows the output of the sector growing in a cyclical manner. The data is included in Table Number 4 below.

The weakness of the time series approach is illustrated by the situation in the early to mid-1970s. Over the period 1971 to 1973 construction appeared to suffer severe capacity problems as evidenced by the escalation in tender prices. Figure Number 4 gives the annual change in value added for construction in constant (2002) prices. This is computed using equation (1).

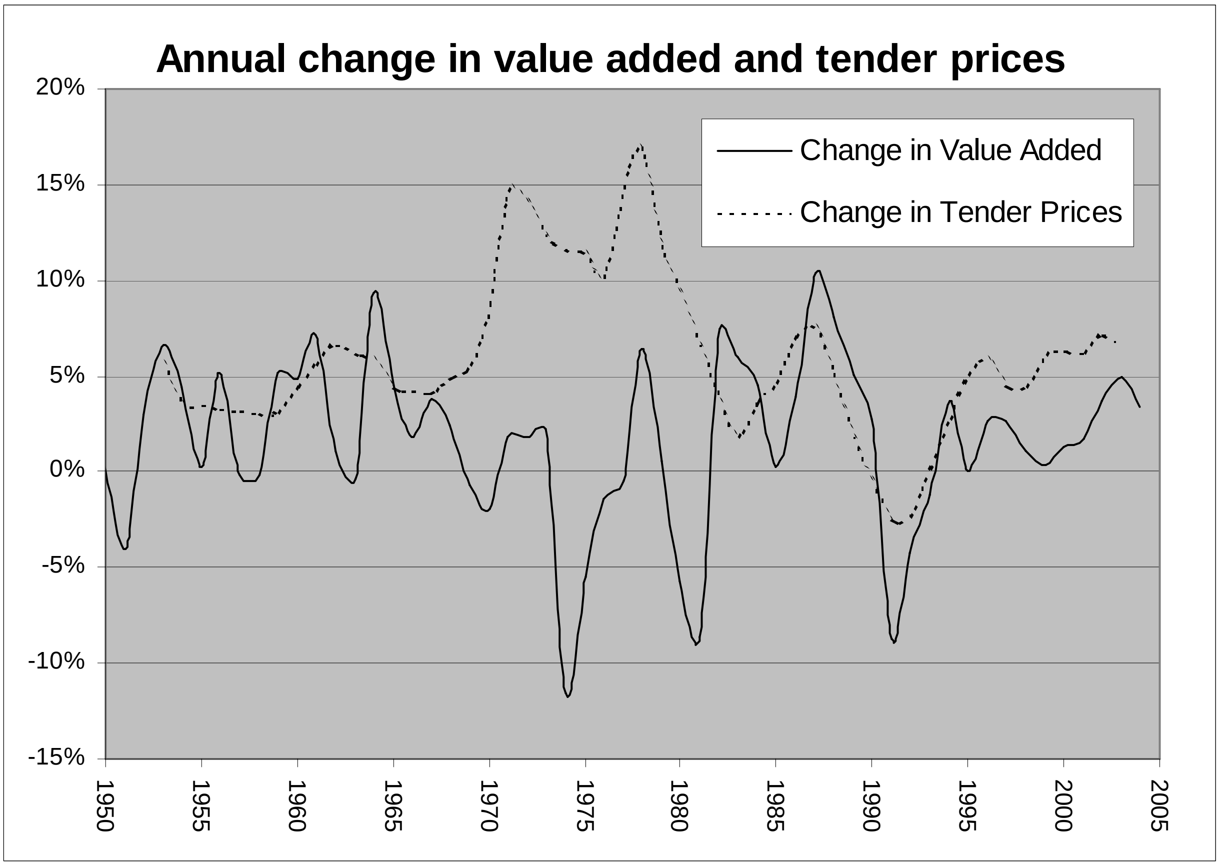
$$\Delta V_t = (V_t - V_{t-1})/V_{t-1} \times 100\% \qquad (1)$$

Where V_t = Construction value added for year t
V_{t-1} = Construction value added for time year t-1
ΔV_t = Change in construction value added from year t-1 to year t

Figure Number 4 also included the annual change in tender prices for the year in question as presented in Table Number 3 below.

While this approach suffers from a number of severe limitations, it does present a basic idea that is expanded on below by comparing the time series for construction output with the changing prices for resource inputs (Inputs in Figure Three) and construction tender prices (Outputs in Figure Three)

Figure Number 4: Annual Change in Value Added for the UK Construction Sector (1950-2005)



4.3: Theoretical issues

As two of the three definitions of capacity are related to price change, the analysis will be based on changes in price and cost indices. Construction may be seen as having a dispersed industrial structure with few barriers to entry (Myers, 2004), Ball et al (2000) identified three issues affecting the ability of construction companies to generate higher than normal profits:

1. Low short-run supply elasticity in construction markets. This obviously relates to the ability of the industry to increase its capacity in line with higher demand. The suggestion is that mark-ups for construction companies will vary over the economic cycle. Companies will be in a position to raise their prices during upturns in demand when capacity limits were being stretched. However they would also face the situation of having to cut margins during downturns in demand.

2. Ease of entry and exit in construction submarkets. This is concerned with economic or structural restrictions placed on the ability of firms to move from one sector of construction to another. For example, the rundown of the council house building programme and motorway construction in the mid-1970s forced firms to switch into new expanding areas such as speculative house building and offshore engineering. The more restrictions on freedom of entry to submarkets

the more likely firms established in the growing sectors will be able to sustain high mark-ups. One example of restrictions to entry might be a reluctance of clients to let work a new entrant to a particular submarket on ground of risk reduction even at the expense of cost implications.

3. The ability of construction firms to earn economic rent. This relates to the exploitation of market position or monopoly power. Ball et al (2000) argued that there was generally little scope for UK contractors to earn economic rent given the structure of the industry and the limited use of plant and equipment, most of which tended to be hired. In addition technical innovation that can yield economic rent for manufacturing firms is unlikely to apply to contractors. Ball et al (2000) did concede that innovation in organizational structure might give some firms sufficient leverage in the short-run to take economic rent.

It is reasonable to assume that the above factors are more likely to apply as output approaches the capacity limit of the industry, or the submarket in question. Rising demand will cause the problems associated with low short-run elasticity of supply to kick in. It may also give contractors, at least in less competitive submarkets, the opportunity to exploit economic rent.

Thus it is proposed to use price and cost indices as proxy variables to help identify the level of capacity working in the industry at a given point in time.

4.4: Changing Prices and Costs

The analysis in this paper will be based on the change in construction resource cost indices (RCI) and tender price indices (TPI). RCI measure the change in prices for the key inputs used by the construction sector such as materials, components, and labour. TPI, on the other hand, measure the change in output prices changed by the industry. The assumption is that if the industry is getting overheated it is likely that TPIs will rise faster than RCIs as firms seek to capitalize on their strong market position. During a slump in construction demand it is assumed that the rise in TPI will be less than the RCI as firms are forced to absorb some of the cost increases to win contracts.

Hence the industry is assumed to be below economic capacity if the RCI runs ahead of the TPI. It is assumed to be above economic capacity when the TPI exceeds the RCI. So the definition of economic capacity is a situation where changes in RCI are matched by changes in TPI.

The data is taken from the Quarterly series published by the Building Cost Information (RICS, 2006) where possible. The RCI is taken from the BCIS General Building Cost Index while the TPI is taken from the BCIS All in Tender Price Index. However as this Quarterly series only extends back to the early 1980s, earlier data was taken from Housing and Construction Statistics (HMSO, 1984). The RCI figures were taken from the Building Cost Indices. The TPI figures were taken from the Department of the Environment (DoE) data produced by the Directorate of Quantity Surveying Services (DQSS). This is not a true tender price index as it is restricted to contracts let by the DoE, but it is probably representative of tender prices and is the best available data.

The two series were seasonally adjusted using a four-quarter moving average to smooth out short-term fluctuations. The computations use equations (2) and (3) below:

$$\Delta RCI_t = (RCI_t - RCI_{t-1})/RCI_{t-1} \times 100\% \quad (2)$$

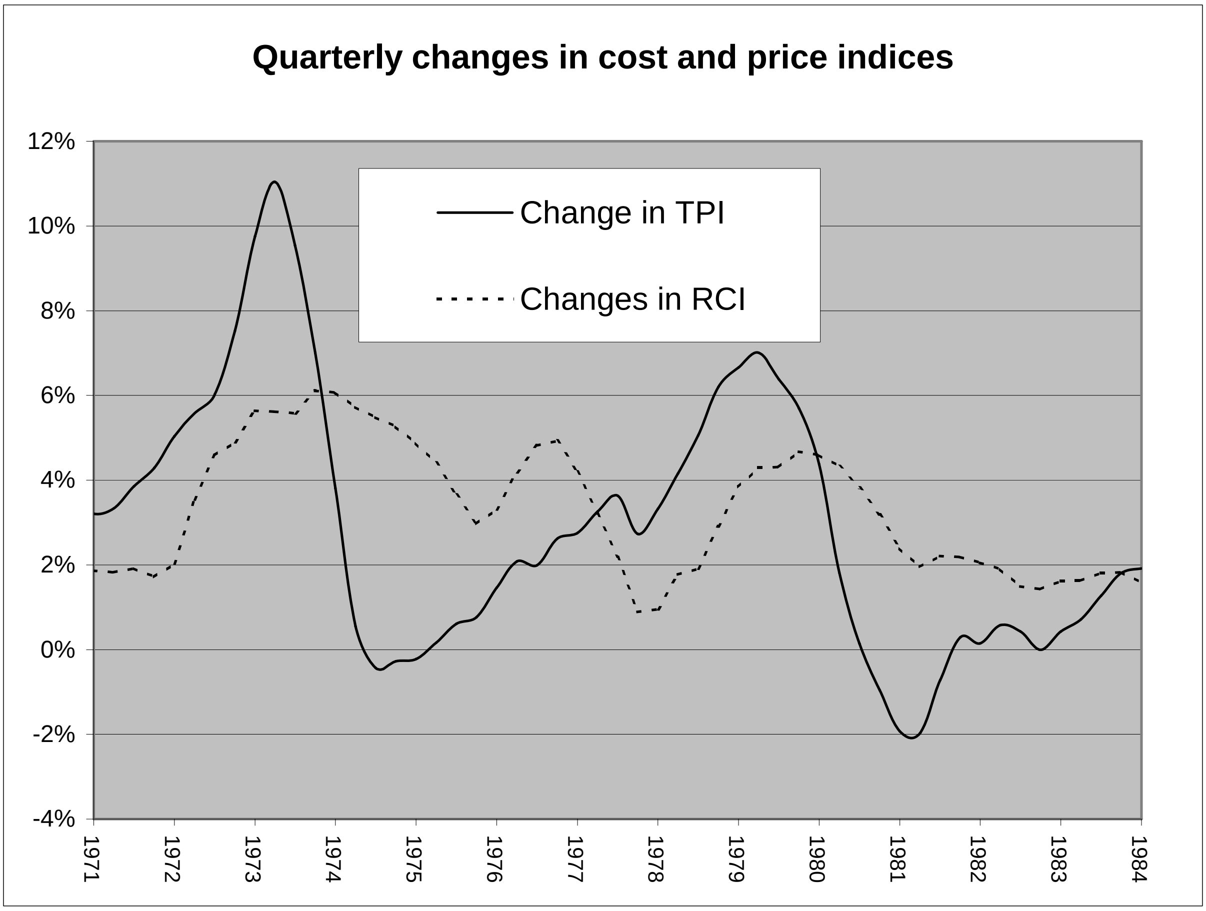
Where RCI_t = Resource cost index for quarter t
RCI_{t-1} = Resource cost index for quarter t-1
ΔRCI_t = Change in resource cost index from quarter t-1 to quarter t

$$\Delta TPI_t = (TPI_t - TPI_{t-1})/ TPI_{t-1} \times 100\% \quad (3)$$

Where TPI_t = Tender price index for quarter t
TPI_{t-1} = Tender price index for quarter t-1
ΔTPI_t = Change in tender price index from quarter t-1 to quarter t

The analysis is based on the assumption that if problems are cause by short supply of input resources — labour, materials, etc — this will be shown by resources costs spiralling upwards ahead of background inflation. If the problems lie with the organization and managerial structure of the construction sector it will be indicated by tender prices rising faster than resource costs and background inflation.

Figure Number 5: Quarterly Change in Cost and Prices Indices for the UK Construction Sector (1971-1984)
Source: Housing and Construction Statistics (HMSO, 1970-1985)

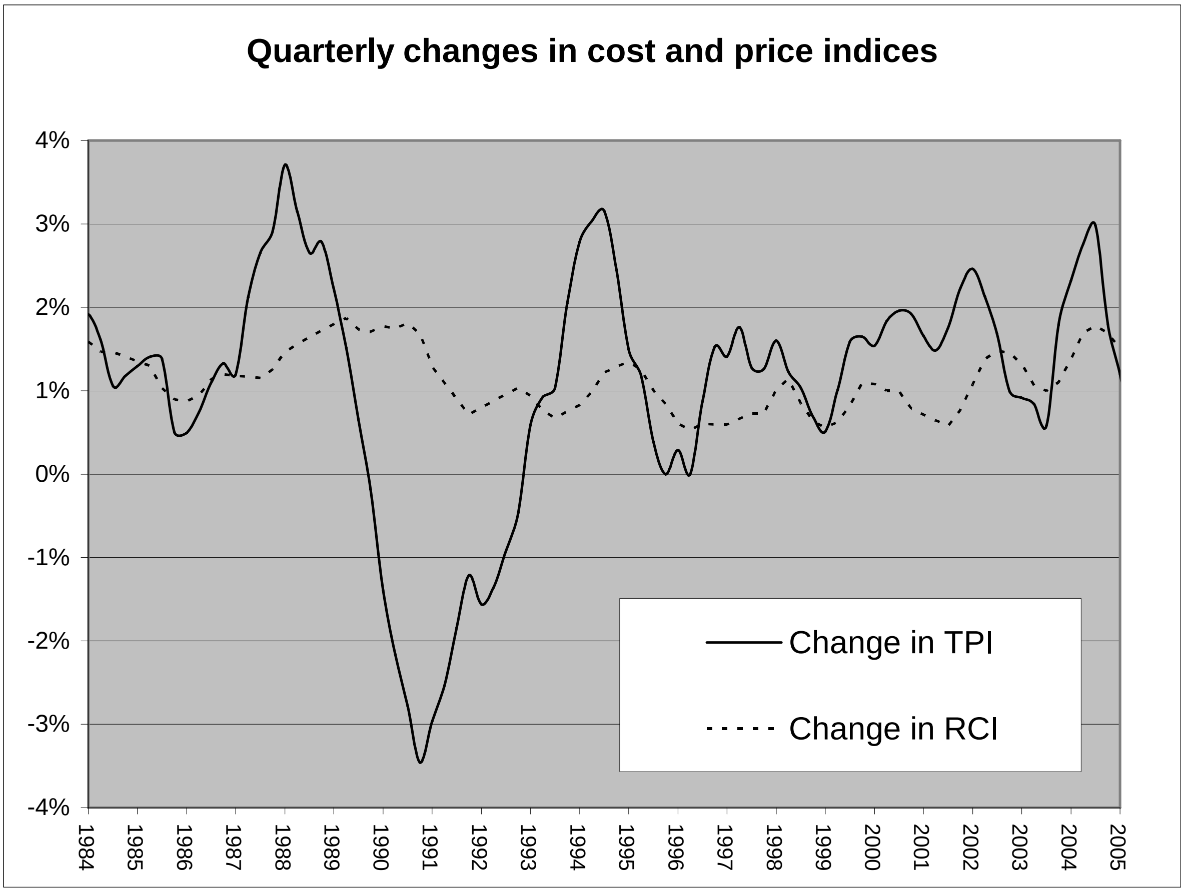


The period 1971 to 1973, illustrated in Figure Number 5, above corresponds with the Dash for Growth instigated by the Conservative Government under Premier Ted Heath and Chancellor Tony Barber. It was the last attempt to expand the economy out of economic difficulties using an old fashioned Keynesian-style boom. Tender prices over this period escalated dramatically. While there was high background inflation, it should be noted that tender price increases were around double the increases in resource costs (Hillebrandt, 1984).

This Dash for Growth had already failed as illustrated by the collapse in tender prices some months before the Arab-Israeli war brought about a 400% increase in the price of oil and plunged the world into a major recession. It appears clear that the high levels of demand as evidenced by the booming tender prices was not reflected in a big increase in construction output. While the output of the industry did go up in monetary terms after allowance for inflation, the annual increase in construction value added was less than 2% per annum over the three years in question. It would appear that either increasing tender prices choked off the extra demand or supply-side constraints curbed output. Maybe a combination of the two is the most likely explanation?

The industry recovered from 1974 and by 1977, tender prices moved ahead of resource costs. The first Gulf War between Iraq and Iran heralded a period of uncertainty and a further oil price ‘spike’ helped push the economy into recession once more with tender prices again collapsing.

Figure Number 6: Quarterly Change in Cost and Prices Indices for the UK Construction Sector (1984-2005)
Source: Building Cost Information Services (RICS, 1980-2006)



Over the period 1984 to 1987 it would appear that the industry was in balance at or near to economic capacity. Towards the end of the 1980s another unsustainable boom hit the industry. This did not affect the whole of the UK, as was the case with the Dash for Growth. It mainly impacted on London and the South East of England plus the M4 corridor. Its epicenter was undoubtedly around Canary Wharf in the London Docklands.

In this case the industry did deliver on increased output. There was a 10% increase in output in 1987, 8% in 1988 and a further 5% in 1989. This was achieved by the attracting large numbers to of construction professionals and operatives to move to the South East from as far afield as Scotland and France

Then the Government became concerned about rising inflation and started to push up interest rates. When this failed to curb rising house and consumer prices subsequent rounds of interest rate increases were applied. Eventually these interest rate increases worked their way through the economy and the industry was plunged into recession. For some firms having two, three, or four contracts let or in progress from the height of the boom cushioned this. This turned out to be a 'double dip' recession as just as recovery seemed to be in sight, a second Europe-wide recession kicked in.

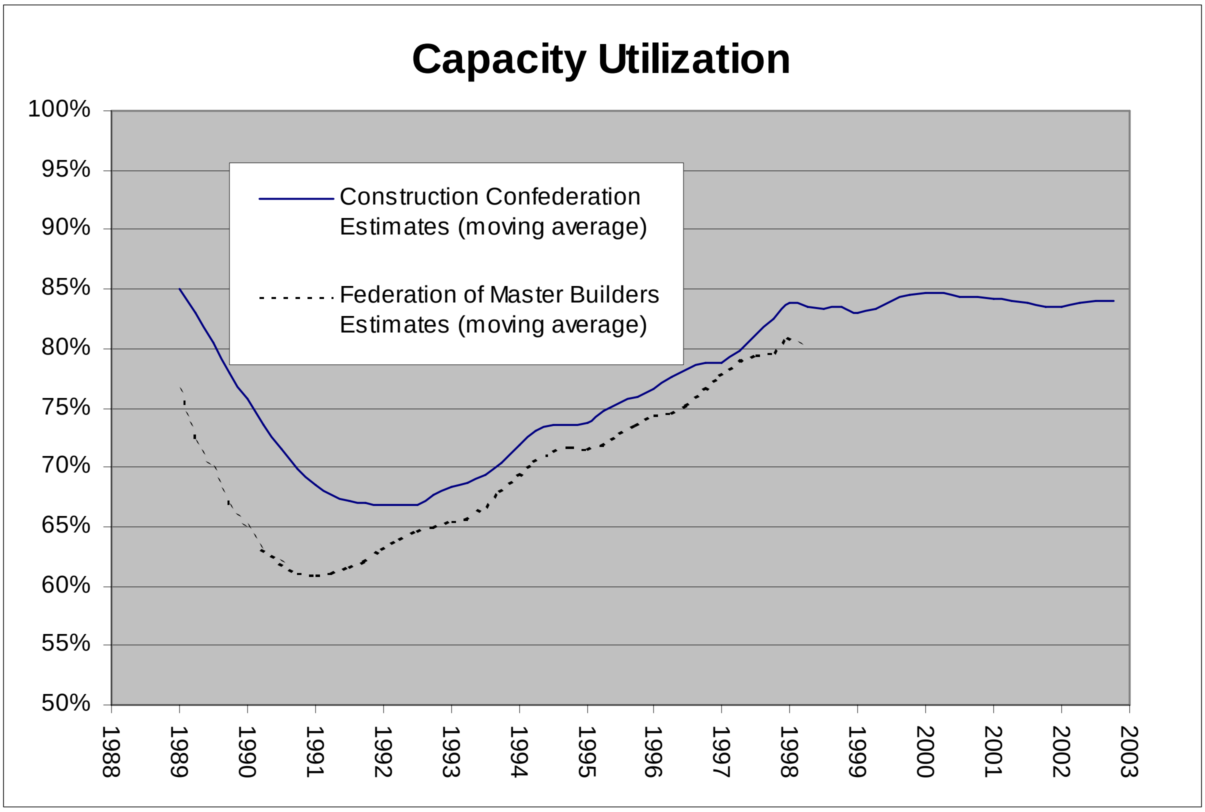
The industry experienced falling output for the next three years before some measure of equilibrium was restored from 1994 onwards. Since then the industry has experienced an unprecedented 11 years of growth. Over this period the TPI have tended to exceed the RCI but by a modest 1% per quarter.

4.5: Calibration of model

To calibrate the model into actual capacity, estimates of capacity utilization from the construction trade associations are employed. The Construction Confederation, successor to the National Federation of Building Trade Employers, conducted surveys of capacity utilization amongst its members. These were presented in the form of the percentage of firms between 90% and 100% of capacity, those between 50% and 90% of capacity and those below 50% of capacity.

The results are included in Table Number 5 below. The overall capacity utilization is estimated assuming average capacities of 95% for the first group, 70% or the second category and 45% for the third group. The Federation of Master Builders carried out a similar survey. The results are illustrated in Figure 7 below:

Figure No 7: Estimated capacity utilization in the UK Construction Sector (1988-2003)
Source: Building Cost Information Services (RICS, 1990-2005)



The results of the two surveys are similar with the FMB figures slightly lower. Also, as expected, the FMB members were hit earlier by the 1989 recession than the larger contractors represented by the Construction Confederation. The smaller builders would be hit quicker by a slump due to relying on projects of shorter duration. The economic capacity would appear to correspond to around 80% and the planning capacity at circa 85% of technological capacity.

4.6: Capacity in context

The figure of 80% may seem rather low for economic capacity in comparison with figures quoted for other sectors of the economy. This may stem from the nature of construction mainly as a series of limited term projects. This has parallels with the idea of frictional unemployment in labour markets. This identifies the mobility reserve needed facilitate employees changing jobs. Construction is particularly prone to frictional unemployment because many operatives are employed by the contract rather than by the company.

Frictional unemployment effectively applies to the firm as well as to labour markets. Spare capacity is needed to cope with change over from one project to another. This is complicated by the fact that projects run down slowly towards their completion and new project take some time to build-up in their early stages. This suggests that construction will run more effectively when operating at around 80% capacity. Process industries, by comparison, can operate at much higher capacities than construction.

Cowling (1982) estimated capital utilization in UK manufacturing to be between 90 and 100% throughout the 1950s into the early 1970s. This did drop as UK manufacturing was badly hit by competition from imports and by the economic recession in the mid-1970s.

Table Number 2: Capacity Utilization in UK manufacturing

Source Cowling: Monopoly Capitalism (1981)

Year	Capacity utilization
1955	98.1
1956	94.6
1957	93.7
1958	90.6
1959	93.2
1960	98.0
1961	95.1
1962	92.0
1963	93.1
1964	98.4
1965	98.4
1966	96.6

Year	Capacity utilization
1967	93.1
1968	94.9
1969	94.9
1970	92.9
1971	89.6
1972	89.7
1973	91.6
1974	85.2
1975	80.9
1976	84.4
1977	84.3
1978	83.6

It would appear to be the case that following sustainable increases in construction, the industry will continue to expand so as to keep output within the range of 80-85% of revised capacity.

5: Conclusions

5.1: Summary of analysis

Over the period it seems that construction resource costs followed movements in retail prices quite closely while tender prices were much more volatile. They surged up and down with the boom bust cycle and have only been stable for a sustained period in recent years. That would suggest that the high prices in times of boom were caused by the industry itself rather than the resource inputs of labour, materials, etc.

Table Number 3 below attempts to summarize the above analysis in terms of the level of capacity working for the UK construction sector:

Table Number 3: Construction capacity 1971-2005

Time Period	**Capacity category**	**Capacity estimate**	**Notes**
1971-1973	Over planning capacity	—	Dash for Growth
1974-1977	Under economic capacity	—	Recession following oil price explosion
1978-1979	Over economic capacity	—	Recovery
1980-1983	Under economic capacity	—	Recession following oil price hike
1984-1986	Economic capacity	—	Recovery
1987-1989	Over planning capacity	85% +	Dockland Boom
1990-1994	Under economic capacity	65%–70%	Double dip recession
1995-1998	Economic capacity	75%–80%	Recovery
1999-2006	Over economic capacity	80%–85%	Sustained growth
2007-	Under economic capacity	65%–70%?	Slump

The objective would appear to be to keep the output of the industry at or around the economic capacity but below the planning capacity. That corresponds to between 80% and 85% of physical capacity using the Construction Confederation figures. This seems to have been achieved from the mid 1990s through to around 2007 but only in 4 years out of the previous 22 years. The remainder mostly involved lurching between boom and slump.

Over recent years the industry has been hovering near to the limit of sustainability at around 85% capacity. However it has not so far produced the adverse effects of the early 1970s or for that matter the late 1980s.

5.2: Explanations for sustained output growth

The question remains as to why the industry has delivered increased output over ten years or more when it failed so conspicuously thirty years ago.

One explanation could involve the removal of constraints on public sector demand. In the early 1970s, cost yardsticks were in place. These made it difficult if not impossible to build hospitals, schools, and social housing without extensive ‘creative accountancy’.

By the late 1970s, cost yardsticks had been scrapped and replaced by cash limits on public sector capital spending. This allowed the Treasury to impose controls on all public sector new building. The advent of Public Finance Initiative and Public Private Partnerships removed the 'dead hand of the Treasury' and permitted a major expansion in public sector construction.

However, this does not explain how the supply-side constraints so apparent in the 1970s have been overcome. Indeed they would presumably have loomed even larger without the demand constraints on public sector work.

The industry has gone through fundamental restructuring over the past thirty years. The shift of the private sector towards design and build and the public sector towards contractor-led procurement systems may be one explanation. The growth of supply chain management and partnering may provide another explanation for the remarkable performance. This should really be no surprise as the move the reorganize construction covered by the Latham and Egan Reports was prompted by the perceived poor performance of the industry.

While the industry was coping, concern remains about what will happen in the build-up to the 2012 London Olympics especially combined with the £10B London Crossrail project (Majekodunmi, 2006). It was suggested that there was potential for a repeat of the situation in the late 1980s when the Dockland developments sucked in construction professionals from Scotland and the English regions. This was also likely to pose problems for Scotland especially if Glasgow's bid to host the 2014 Commonwealth Games is successful.

There have been suggestions from the Office of Government Commerce, that panels be established to anticipate construction bottlenecks (OGC, 1973). This echoes the idea of Public Procurement Agency to smooth out the flow of public sector contracts that was initially proposed in the 1970s in the controversial Labour Party Document "Building Britain's Future" (Labour Party 1977). The new Public Sector Construction Clients' Forum (PSCCF) is intended to focus on leading the drive for further improvements in whole-life value for money in the procurement of built environment in the public sector.

It is fair to say that the industry just about coped through the long boom but is very near to the margin of sustainability and care needs to be taken to avoid a repetition of the scenario from the late 1980s or even a repeat of the damaging consequences of the early 1970s boom and bust cycle.

5.3: The current recession and beyond

The credit crunch and the subsequent recession allay any fears about the consequences of the industry being unable to deliver. However the recession has not necessarily solved the problem but merely postponed it.

May construction firms and professional consultants have responded by cutting staff. Some of the redundant staff and operatives could end up being lost to the industry permanently.

The question remains as to what will happen when the economy does start to recover. There could be a flood of work unleashed on the construction sector that it will be unable to satisfy and all the problems of an under capacity including price inflation as experienced in the 1970s and 1980s.

The industry have to cope with replacing the ‘baby boom’ generation who have been a major component in the workforce as they retire over the next five years or so. They will also have to replace those ‘shaken out’ in the current recession.

Table Number 4: Construction Value Added for the UK (1948-2004)
Source: UK National Accounts (HMSO, 2006) BCIS (RICS, 2006

Year	***Index of Output***	**Value Added (£M)**	**Annual Changes (%)**			
			Output	**Tender Prices**	**Resource Costs**	**Retail Prices**
1953	43.5	£23,831	6.67%	5.7%	—	5.8%
1954	45.5	£24,926	4.40%	3.6%	—	5.5%
1955	45.6	£24,981	0.22%	3.4%	—	3.4%
1956	48.1	£26,351	5.20%	3.3%	—	3.3%
1957	48.0	£26,296	-0.21%	3.2%	—	3.2%
1958	47.9	£26,241	-0.21%	3.1%	—	1.6%
1959	50.5	£27,665	5.15%	3.0%	—	1.5%
1960	53.1	£29,090	4.90%	4.4%	—	1.5%
1961	57.2	£31,336	7.17%	5.6%	—	1.5%
1962	57.8	£31,665	1.04%	6.7%	—	2.9%
1963	57.6	£31,555	-0.35%	6.3%	—	4.3%
1964	63.5	£34,787	9.29%	5.9%	—	2.7%
1965	66.5	£36,431	4.51%	4.4%	—	4.0%
1966	67.7	£37,088	1.77%	4.3%	—	3.8%
1967	70.4	£38,567	3.84%	4.1%	—	3.7%
1968	72.2	£39,553	2.49%	4.9%	—	4.8%
1969	71.7	£39,279	-0.70%	5.6%	—	5.7%
1970	70.3	£38,512	-1.99%	8.8%	—	6.5%
1971	71.6	£39,225	1.82%	14.6%	—	8.1%
1972	72.9	£39,937	1.78%	14.2%	—	10.3%
1973	74.6	£40,868	2.28%	12.4%	—	13.6%
1974	66.9	£36,650	-11.51%	11.6%	18.3%	15.7%
1975	63.4	£34,732	-5.52%	11.4%	19.0%	16.8%
1976	62.5	£34,239	-1.44%	10.2%	16.6%	15.5%
1977	62.2	£34,075	-0.48%	14.9%	15.7%	14.8%
1978	66.5	£36,431	6.47%	16.8%	15.4%	14.6%
1979	66.9	£36,650	0.60%	11.7%	14.1%	13.5%
1980	63.3	£34,678	-5.69%	9.4%	12.7%	11.9%
1981	58.3	£31,938	-8.58%	6.6%	11.5%	10.6%
1982	63.0	£34,513	7.46%	3.7%	9.8%	8.8%
1983	67.0	£36,705	5.97%	1.8%	7.5%	6.9%
1984	70.2	£38,458	4.56%	3.7%	6.1%	5.6%
1985	70.4	£38,567	0.28%	4.6%	5.3%	4.6%
1986	73.3	£40,156	3.96%	7.0%	5.2%	4.8%
1987	81.8	£44,812	10.39%	7.5%	5.5%	5.4%
1988	89.0	£48,757	8.09%	5.1%	6.0%	6.2%
1989	93.7	£51,332	5.02%	1.8%	6.2%	6.5%
1990	96.4	£52,811	2.80%	-0.3%	5.8%	6.3%
1991	88.7	£48,593	-8.68%	-2.5%	5.3%	5.3%
1992	85.1	£46,620	-4.23%	-2.4%	4.5%	4.5%
1993	84.1	£46,073	-1.19%	0.2%	4.1%	3.3%
1994	87.3	£47,826	3.67%	2.7%	3.7%	2.7%
1995	87.3	£47,826	0.00%	5.0%	3.5%	2.6%
1996	89.7	£49,140	2.68%	5.9%	3.5%	3.0%
1997	92.1	£50,455	2.61%	4.5%	3.3%	2.8%
1998	93.1	£51,003	1.07%	4.5%	3.2%	2.8%
1999	93.4	£51,167	0.32%	6.1%	3.1%	2.6%
2000	94.6	£51,825	1.27%	6.4%	3.6%	2.3%
2001	96.3	£52,756	1.77%	6.2%	3.9%	2.1%
2002	100.0	£54,783	3.70%	7.1%	4.4%	2.4%
2003	105.2	£57,632	4.94%	6.7%	4.8%	2.3%
2004	108.9	£59,659	3.40%	—	—	—

Table Number 5: Construction Confederation and Federation of Master Builders Estimates of Capacity (1989-2003)

Year	Quarter	Estimate by Construction Confederation (CC)			CC Capacity moving average)	FMB Capacity moving average
		90% Plus	50%-90%	Less than 50%		
1989	Q1	61	38	2	85%	76%
	Q2	53	45	4	83%	72%
	Q3	45	51	6	80%	70%
	Q4	36	58	7	78%	67%
1990	Q1	28	64	9	76%	65%
	Q2	23	66	11	74%	63%
	Q3	19	69	14	72%	62%
	Q4	14	71	16	70%	61%
1991	Q1	9	73	18	69%	61%
	Q2	9	73	19	68%	61%
	Q3	8	73	19	67%	62%
	Q4	8	73	20	67%	62%
1992	Q1	7	73	20	67%	63%
	Q2	7	75	19	67%	64%
	Q3	6	77	17	67%	65%
	Q4	6	78	16	68%	65%
1993	Q1	5	80	14	68%	65%
	Q2	5	84	20	69%	66%
	Q3	7	77	14	69%	67%
	Q4	7	82	11	70%	68%
1994	Q1	17	69	14	72%	69%
	Q2	35	58	7	73%	71%
	Q3	28	64	6	74%	71%
	Q4	25	55	20	74%	72%
1995	Q1	14	84	2	74%	72%
	Q2	23	76	1	75%	72%
	Q3	27	73	0	76%	73%
	Q4	25	73	2	76%	74%
1996	Q1	21	78	1	77%	74%
	Q2	29	70	1	78%	75%
	Q3	45	54	1	78%	75%
	Q4	35	65	0	79%	77%
1997	Q1	34	65	1	79%	78%
	Q2	41	53	2	80%	79%
	Q3	47	53	0	81%	80%
	Q4	64	35	2	82%	80%
1998	Q1	43	56	1	84%	81%
	Q2	64	35	1	84%	80%
	Q3	57	43	0	83%	—
	Q4	49	46	5	83%	—
1999	Q1	59	40	1	83%	—
	Q2	51	48	1	83%	—
	Q3	54	46	0	84%	—
	Q4	58	41	1	85%	—
2000	Q1	67	33	0	85%	—
	Q2	59	41	0	85%	—
	Q3	53	45	2	84%	—
	Q4	60	37	3	84%	—
2001	Q1	61	38	1	84%	—
	Q2	63	37	0	84%	—
	Q3	47	50	3	84%	—
	Q4	57	43	0	84%	—
2002	Q1	57	42	1	84%	—
	Q2	56	44	0	84%	—
	Q3	52	47	1	84%	—
	Q4	59	41	0	84%	—

References

Ball, Michael, Farshchi, Mantab & Grillo, Maurizio (2000)	Competition and persistence of profits in the UK construction industry, Construction Management and Economics, 18, pp 733-**45**.
Brown, Michael A (2004)	The truth about capacity, Construction Manager, October 2004
BCIS (2006)	Building Cost Information Service On-line, Royal Institution of Chartered Surveyors, London.
Cowling, Keith (1982)	Monopoly Capitalism, Macmillan, London
Egan, Sir John (1998)	Rethinking construction, Department of Trade and Industry, HMSO, London
Hall, Peter (1982)	Great planning disasters, University of California Press, Berkley.
Hillebrandt, Patricia (1975)	The capacity of the construction industry in Turin, D A (Editor): Aspects of the economics of construction, George Godwin, London, pp 25-57.
Hillebrandt, Patricia (1984)	Analysis of the British construction industry, Macmillan, London.
Housing and Construction Statistics (1970-1984)	Housing and Construction Statistics, Department of the Environment, Scottish Development Department, and Welsh Office, HMSO, London.
Kitching, Ruby (2006)	Chase me chase me (skill shortages), New Civil Engineer, March 2006.
Labour Party (1977)	Building Britain's future, Labour's policy on construction, Labour Party, London.
Latham, Michael (1994)	Constructing the team, Department of the Environment, HMSO, London
Majekodunmi, Olufunmi (2006)	The lure of the rings, Construction Manager, January 2006.
Myers, Danny (2004)	Construction Economics: a new approach, Spon, London

NEDO (1975)	The public client and the construction industry (the Wood Report) Building and Civil Engineering Economic Development Committees, National Economic Development Office, HMSO, London.
OGC (2003)	Increased competition and improving long-term capacity planning in the government market place, Office of Government Commerce, HM Treasury, London.
Panic, M (1978)	Capacity utilisation in UK manufacturing industry, National Economic Development Office, HMSO, London.
Parry Lewis, John (1967)	The capacity of the building industry, Building, 12 May 1967.
Taylor, Jim; Winter, David; and Pearce, David (1970)	A nineteen industry quarterly series of capacity utilization in the United Kingdom 1948 - 1968, Bulletin, University of Oxford, Institute of Economics and Statistics, May 1970, pp 113-131.